CLAIMS:

1. A structure to interact with electromagnetic waves by changing optical aspect in selected areas in response to an external signal, the structure comprising:

a plurality of optically anisotropic responsive elements, each responsive element capable of presenting at least two different optical aspects and changing between the optical aspects based on an applied external signal;

a support substrate containing the responsive elements, the support substrate having a surface structure which define receiving positions for the responsive elements; and

an array of transparent lenses, at least a part of each lens being in direct contact with a receiving position on the surface structure of the support substrate such that the receiving position at least in part inherently defines the lens shape and location.

2. The structure of claim 1, wherein the structure is a visual display and the responsive elements are optically anisotropic pertaining to a visible light.

3. The structure of claim 1, wherein the external signal is an electromagnetic field.

4. The structure of claim 1, wherein the responsive elements are rotating particles.

5. The structure of claim 4, wherein the particles are spheroid balls.

6. The structure of claim 1 wherein support substrate is three-dimensionally micro fabricated.

7. The structure according to claim 1, wherein each lens is a converging lens.

8. The structure of claim 7, wherein:

each lens has a focal length and each responsive element has a portion imparting a visual aspect, the portion being substantially positioned within the focal length from the associated lens.

9. The structure according to claim 1, wherein:

each lens has a perimeter edge, the edge being in direct contact with the top perimeter edge of the associated receiving position.

10. The structure according to claim 1, wherein:

the lens array is formed using a lens-forming film laid across the substrate after the responsive elements are placed into the support substrate.

11. The structure according to claim 10, wherein the lens-forming film

fluidly directly seals the responsive elements within the substrate.

12. The structure of claim 2, wherein each lens enlarges image of at least a portion of the responsive element or elements positioned below the lens by refracting the light reflected therefrom.

13. The structure of claim 1, wherein the support substrate has two major sides, one major side being opaque.

14. The structure of clam 13, wherein the opaque side to of the support substrate comprises an opaque cover plate bonded to the rest of the support the substrate.

15. The structure of claim 1, wherein each receiving position contains only one responsive element.

16. The structure of claim 1, further comprising a filler material at least partially surrounding each particle.

17. The structure of claim 16, wherein:

the filler material exerts a force on the particles, the force being sufficient to keep the particles bistable but not excessive as to prevent the particles from a rotating upon the application of the electromagnetic field.

18. The structure of claim 2, further comprising a top cover laid across

the supporting structure and the responsive element contained therein, the top cover being transparent and non-reflective.

19. A display which can communicate visual information by changing color in selected areas responsive to an electromagnetic field, the display comprising:

a plurality of chromatic display particles being visible on the surface of the display, each display particle capable of presenting at least two different optical aspects and changing between the optical aspects based on an applied electromagnetic field, and being optically reflective and substantially non-transmissive in each of the two optical aspects;

a support substrate containing the chromatic display particles, the support substrate having a surface structure which defines receiving positions for the particles; and

an array of transparent lenses displaced parallel to the support substrate, with each lens corresponding to one receiving position and at least one particle, wherein the lens, the receiving position and the particle or particles in correspondence with lens together define a display unit.

20. The display of claim 19, wherein the support substrate has two major sides, one major side being opaque.

21. The display of clam 20, wherein the opaque side of the support substrate comprises an opaque cover plate bonded to the rest of the support the substrate.

22. The display of claim 19, further comprising a filler material at least partially surrounding each particle.

23. The display of claim 19, wherein:

the filler material exerts a force on the particles, the force being sufficient to keep the particles bistable but not excessive as to prevent the particles from rotating upon the application of the electromagnetic field.

24. The display of claim 19, wherein:

the chromatic display particles have a particle size, and the receiving positions have a first viewing aperture which is smaller than the particle size.

25. The display of claim 24, wherein each lens defines a second viewing aperture which is greater than the first viewing aperture.

26. A method of making a structure to interact with electromagnetic waves, the method comprising:

making a substrate, the substrate having a plurality of cavities;

placing a plurality of responsive elements in the cavities, and when placed in the cavities, each responsive element being optically anisotropic with respect to an electromagnetic wave, with each responsive element capable of presenting at least two different optical aspects and changing between the optical aspects based on an external signal; and

forming an array of optical lenses directly on the substrate, each optical lens being connected to a said cavity.

27. The method of claim 26, wherein the structure is a visual display and the responsive elements are optically anisotropic with respect to a visible light.

28. The method of claim 26, wherein the external signal is an electromagnetic field.

29. The method of claim 26, wherein the display elements are rotating particles.

30. The method according to claim 29, further comprising: adding a filler material into each cavity, the filler material being selected and positioned so that the filler material exerts a force on the particles, the force being sufficient to keep the particles bistable but not excessive as to prevent the particles from a rotating upon the application of the electromagnetic field.

31. The method of claim 26 wherein support substrate is three-dimensionally micro fabricated.

32. The method claim 26, wherein each lens is a converging lens.

33. The method of claim 25, wherein each optical lens enlarges an image from at least a portion of the visible side of a said display element associated with the optical lens.

34. The method of claim 26, wherein the step of forming an array of lenses comprises:

placing a top layer over the cavities, the top layer comprising a lens-forming layer; and

forming an array of lenses from the lens-forming layer.

35. A method of making a visual display apparatus, the method comprising:

making a substrate, the substrate having a plurality of cavities;

placing a plurality of optically anisotropic display elements in the cavities, and when placed in the cavities, each display element having a visible side, each display element capable of presenting at least two different optical aspects and changing between the optical aspects based on an external signal

adding an array of optical lenses on the substrate, each optical lens being individually connected to a display unit, each optical lens further enlarging an image from at least a portion of the visible side of each element belong to the corresponding display unit; and

making the visual display apparatus optically non-transmissive.

36. The method of claim 35, wherein the display elements are rotating particles.

37. The method of claim 35, wherein the particles are spheroid balls.

38. The method of claim 35 wherein support substrate is three-dimensionally micro fabricated.

39. The method claim 35, wherein each lens is a converging lens.

40. The method of claim 35, wherein:

adding an optical lens on the substrate comprises directly forming the optical lens on the substrate.

41. The method of claim 35, wherein:

making the visual display apparatus optically non-transmissive comprises adding an opaque bottom layer or plate to a side of the substrate.